

The biological importance of water

depends on its physical properties.

Solvent properties: allow water to act as a transport medium for polar solutes.

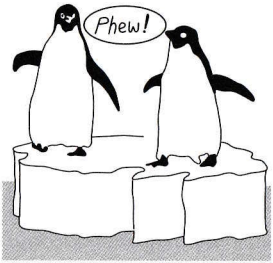
For example:

- movements of minerals to lakes and seas;
- transport via blood and lymph in multicellular animals;
- removal of metabolic wastes such as urea and ammonia in urine.

Transpiration stream: the continuous column of water is able to move up the xylem because of cohesion between water molecules and adhesion between water and the walls of the xylem vessels.

Molecular mobility: the rather weak nature of individual hydrogen bonds means that water molecules can move easily relative to one another - this allows *osmosis* (vital for uptake and movement of water) to take place.

Expansion on freezing: since ice floats it forms at the surface of ponds and lakes - it therefore insulates organisms in the water below it, and allows the ice to thaw rapidly when temperatures rise. Changes in density also maintain circulation in large bodies of water, thus helping nutrient cycling. Floating ice also means that penguins and polar bears have somewhere to stand!

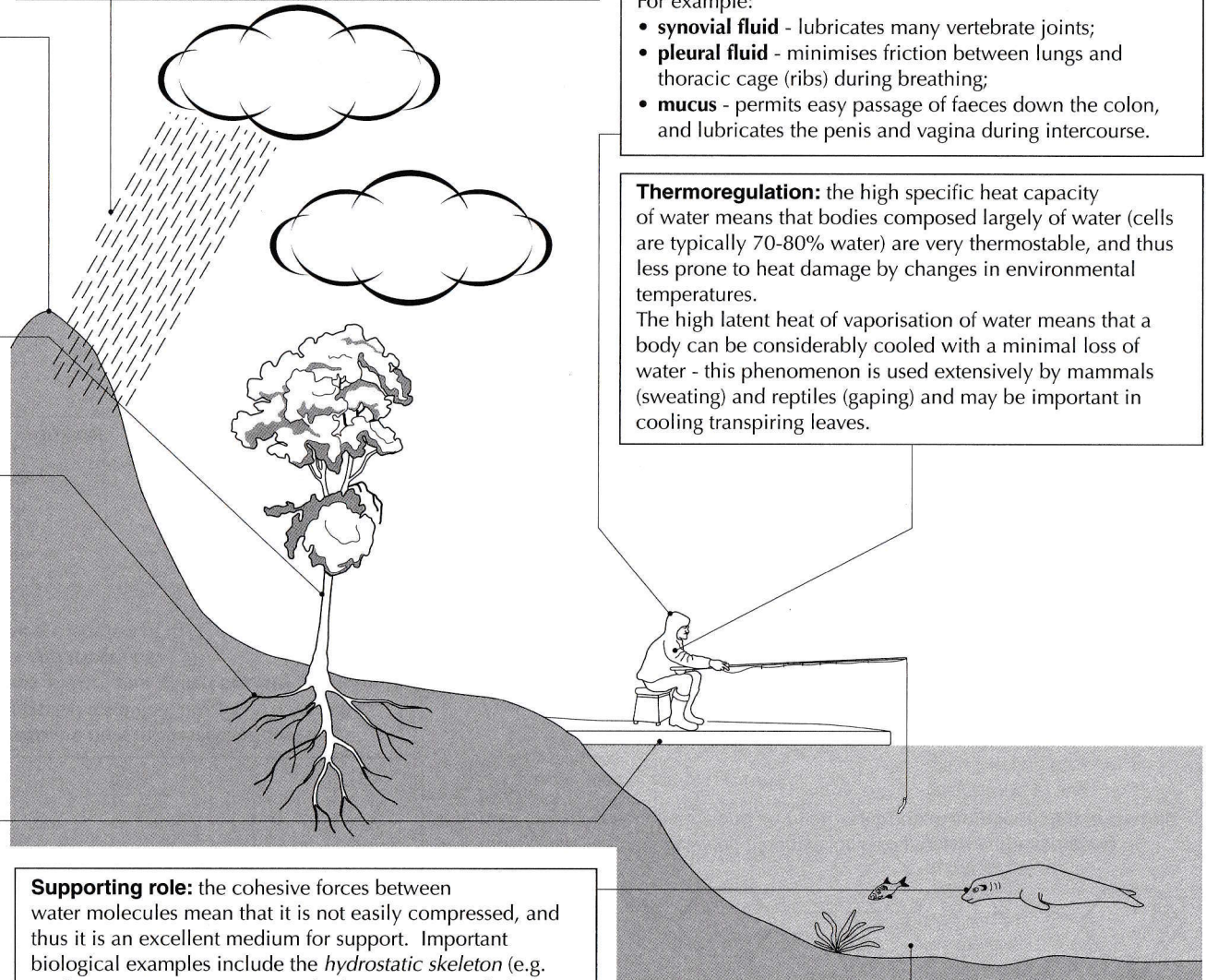


Metabolic functions

Water is used directly ...

- as a reagent (source of reducing power) in photosynthesis;
 - to hydrolyse macromolecules to their subunits, in digestion for example;
- ... and is also the medium in which all biochemical reactions take place.

Volatility/stability: is balanced at Earth's temperatures so that a water cycle of evaporation, transpiration and precipitation is maintained.



Lubricant properties: water's cohesive and adhesive properties mean that it is viscous, making it a useful lubricant in biological systems.

For example:

- **synovial fluid** - lubricates many vertebrate joints;
- **pleural fluid** - minimises friction between lungs and thoracic cage (ribs) during breathing;
- **mucus** - permits easy passage of faeces down the colon, and lubricates the penis and vagina during intercourse.

Thermoregulation: the high specific heat capacity of water means that bodies composed largely of water (cells are typically 70-80% water) are very thermostable, and thus less prone to heat damage by changes in environmental temperatures.

The high latent heat of vaporisation of water means that a body can be considerably cooled with a minimal loss of water - this phenomenon is used extensively by mammals (sweating) and reptiles (gaping) and may be important in cooling transpiring leaves.

Supporting role: the cohesive forces between water molecules mean that it is not easily compressed, and thus it is an excellent medium for support. Important biological examples include the *hydrostatic skeleton* (e.g. earthworm), *turgor pressure* (in herbaceous parts of plants), *amniotic fluid* (which supports and protects the mammalian foetus) and as a *general supporting medium* (particularly for large aquatic mammals such as whales).

Transparency: water permits the passage of visible light. This means that photosynthesis (and associated food chains) is possible in relatively shallow aquatic environments.